Ministry of Communications
and Information Technology

egypt fwd
initiative

مستقبلنا رقمي

Automotive door control system design

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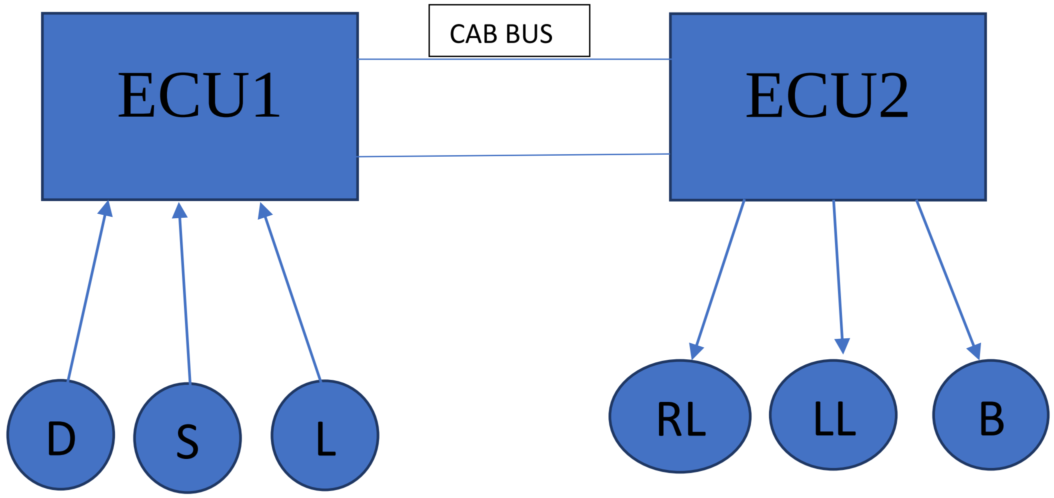
System schematic Diagram



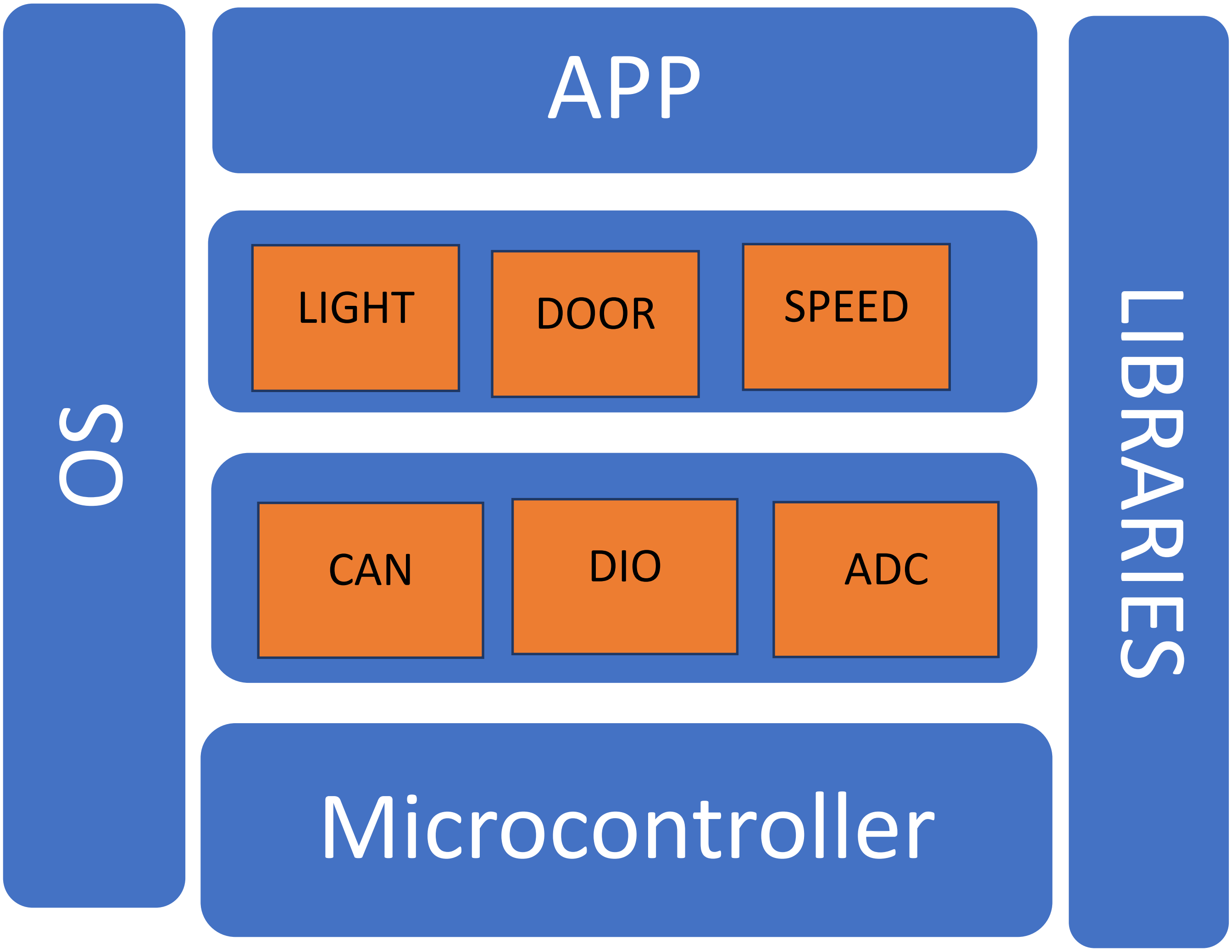
Software Requirements:

- Door status will be sent every 10ms.
- Light status will be sent every 20ms.
- Speed status will be sent every 5ms.
- If the door is opened while the car is moving → Buzzer ON, Lights OFF.
- If the door is opened while the car is stopped → Buzzer OFF, Lights ON.
- If the door is closed while the lights were ON → Lights are OFF after 3 seconds.
- If the car is moving and the light switch is pressed → Buzzer OFF, Lights ON.
- If the car is stopped and the light switch is pressed → Buzzer ON, Lights ON.

Static Design

For ECU1:

layered architecture:



Components and modules:

Modules:

- **MCAL**
  - ➢ CAN
  - ➢ DIO
  - ➢ ADC
- **HAL**
  - ➢ LIGHT
  - ➢ DOOR
  - ➢ SPEED
- **Communication Layer**
  - ➢ BCM
- **Sharable Layers**
  - ➢ OS
  - ➢ Libraries

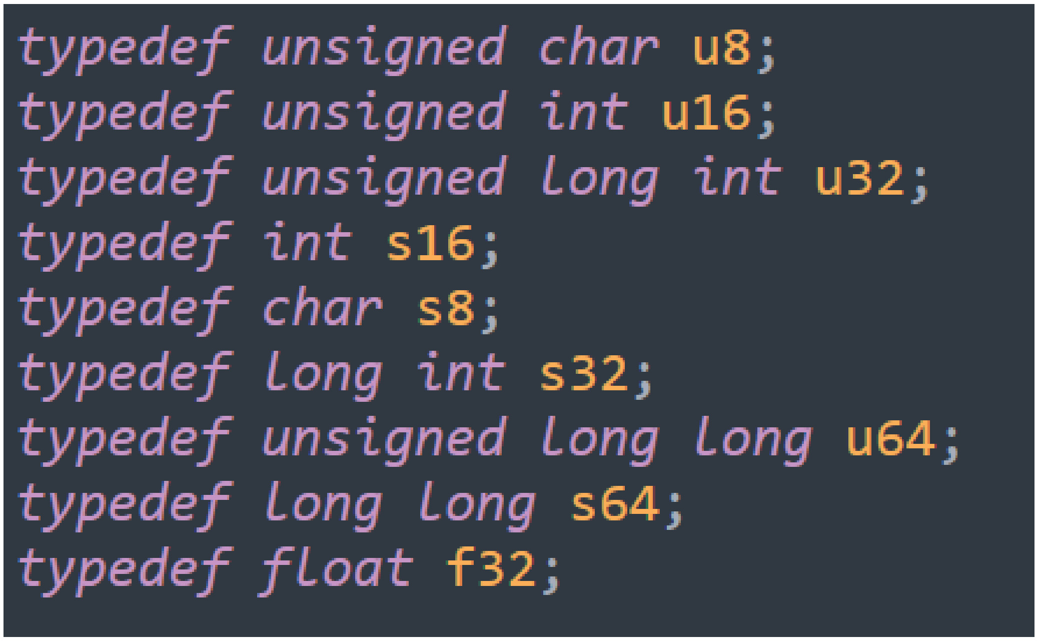
Components:

- Door sensor
- Light sensor
- Speed sensor

APIS:

- CAN
  - Void CAN_INIT ()
  - Void CAN_Send (u32 data)
  - U32 CAN_recieve ()
- DIO
  - Void DIO_INIT ()
  - Void DIO_DirectionSet (u8 DIR)
  - Void DIO_PINSet (u8 STATE)
  - U8 DIO_GETPIN ()
- ADC
  - Void ADC_INIT ()
  - Void ADC_StartConversion (u16 data)
  - U16 ADC_DigitalOut ()
- LIGHT
  - U8 LIGHT_STATE ()
- DOOR
  - U8 DOOR_STATE ()
- SPEED
  - U16 SPEED_RPM ()
- BCM
  - Void BCM_INIT ()
  - Void BCM_Send (u32 data)
  - U32 BCM_recieve ()

- **Used Typedef**



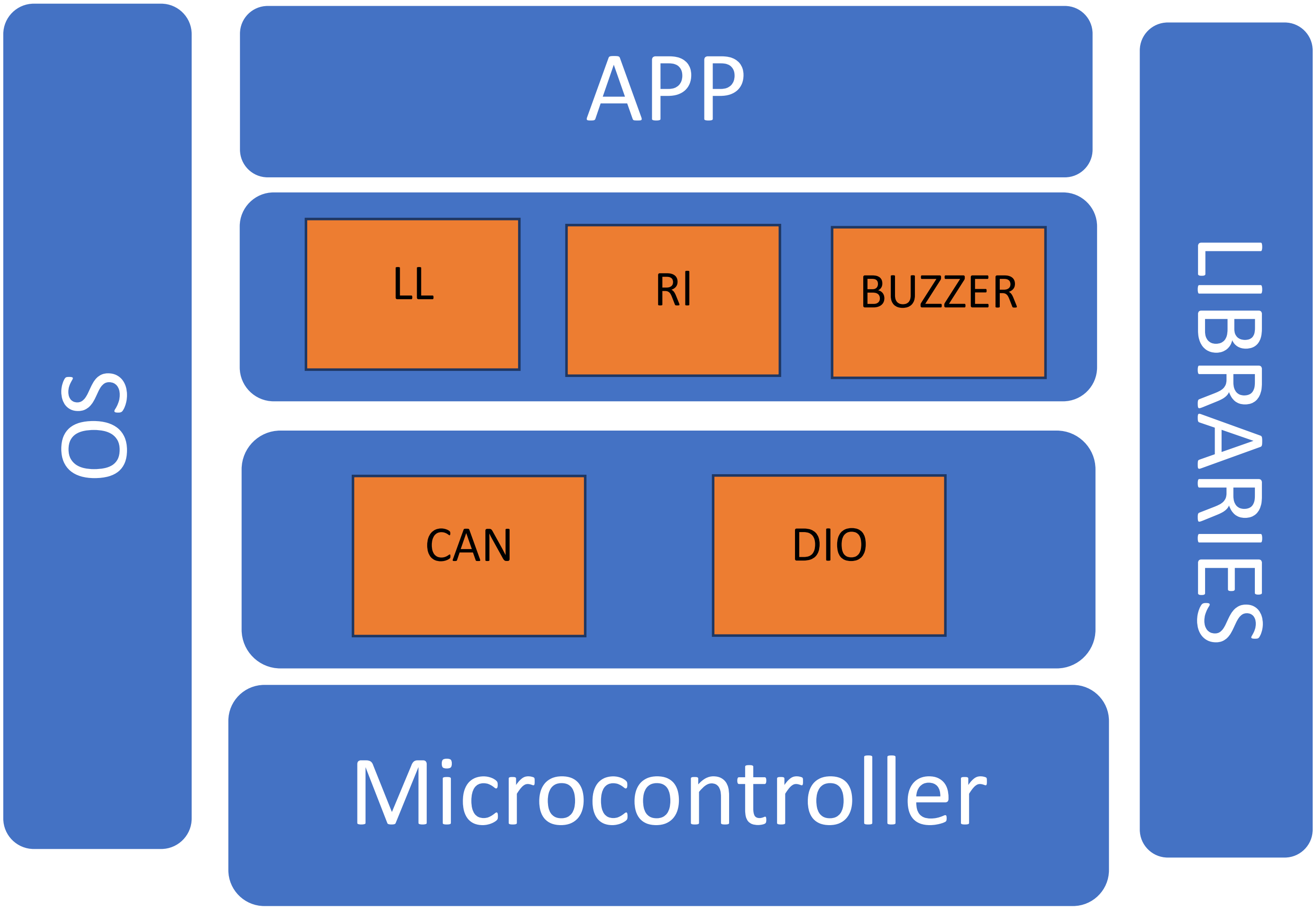
```c
typedef unsigned char u8;
typedef unsigned int u16;
typedef unsigned long int u32;
typedef int s16;
typedef char s8;
typedef long int s32;
typedef unsigned long long u64;
typedef long long s64;
typedef float f32;
```

Folder Structure

- Project
  - **MCAL**
    - CAN
    - DIO
    - ADC
      - **HAL**
        - DOOR
        - LIGHT
        - SPEED
          - **APP**
            - APP
              - **Main**
                - Main ()

For ECU2:

layered architecture:



Components and modules:

Modules:

- **MCAL**
  - ➢ CAN
  - ➢ DIO
- **HAL**
  - ➢ Left Light
  - ➢ Left Light
  - ➢ Buzzer
- **Communication Layer**
  - ➢ BCM
- **Sharable Layers**
  - ➢ OS
  - ➢ Libraries

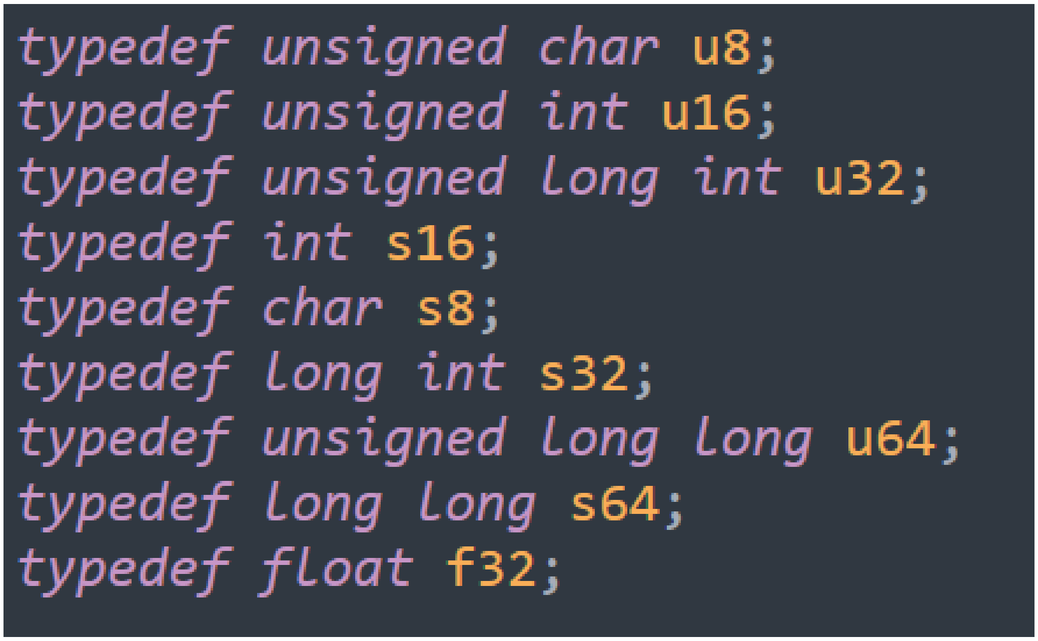
Components:

- Left Light
- Right Light
- Buzzer

APIS:

- CAN
  - Void CAN_INIT ()
  - Void CAN_Send (u32 data)
  - U32 CAN_recieve ()
- DIO
  - Void DIO_INIT ()
  - Void DIO_DirectionSet (u8 DIR)
  - Void DIO_PINSet (u8 STATE)
  - U8 DIO_GETPIN ()
- Left LIGHT
  - Void Left_ LIGHT_ON ()
  - Void Left_ LIGHT _OFF ()
- Buzzer
  - Void Buzzer_ON ()
  - Void Buzzer_OFF ()
- Right Light
  - Void Right_ LIGHT_OFF ()
  - Void Right_ LIGHT_ON ()
- BCM
  - Void BCM_INIT ()
  - Void BCM_Send (u32 data)
  - U32 BCM_recieve ()

- **Used Typedef**



```c
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typedef unsigned long int u32;
typedef int s16;
typedef char s8;
typedef long int s32;
typedef unsigned long long u64;
typedef long long s64;
typedef float f32;
```

Folder Structure

- Project

  MCAL
  - CAN
  - DIO

    HAL
    - Buzzer
    - Left LIGHT
    - Right Light

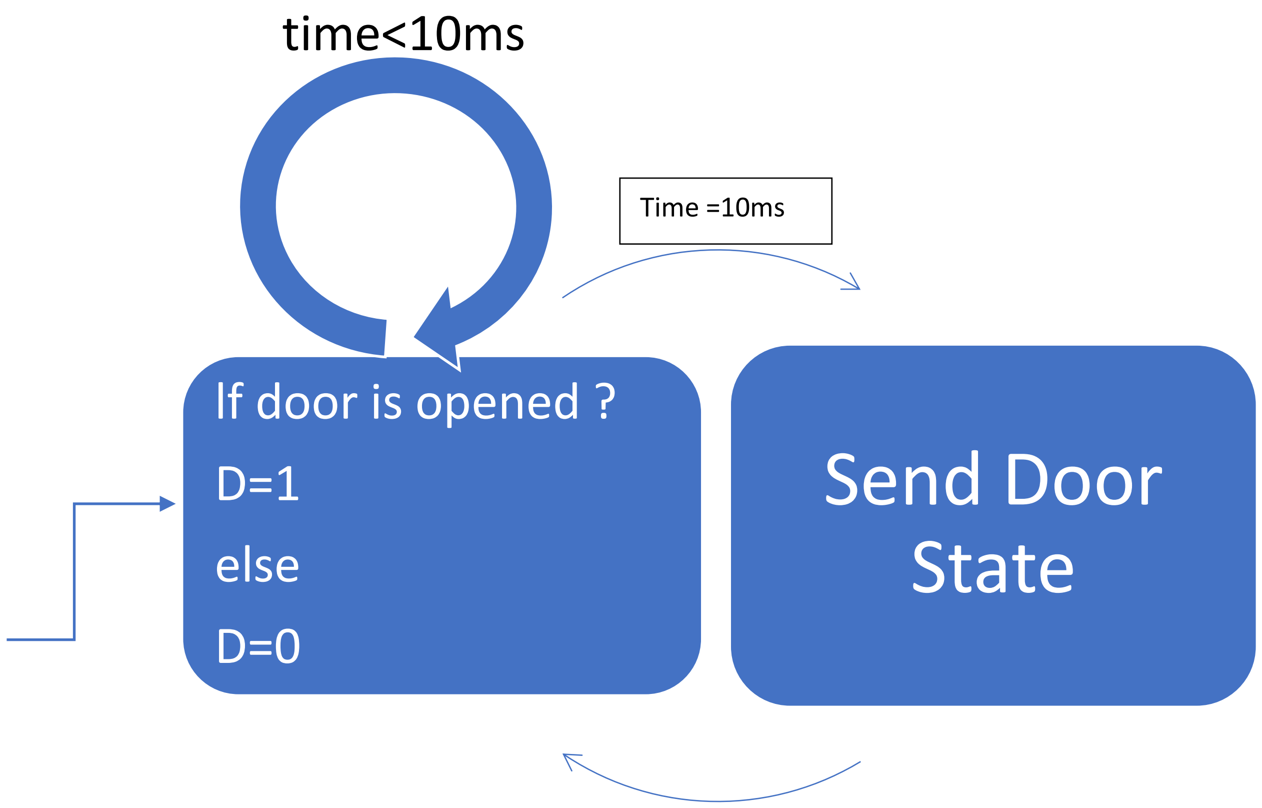
      APP
      - APP

        Main
        - Main ()

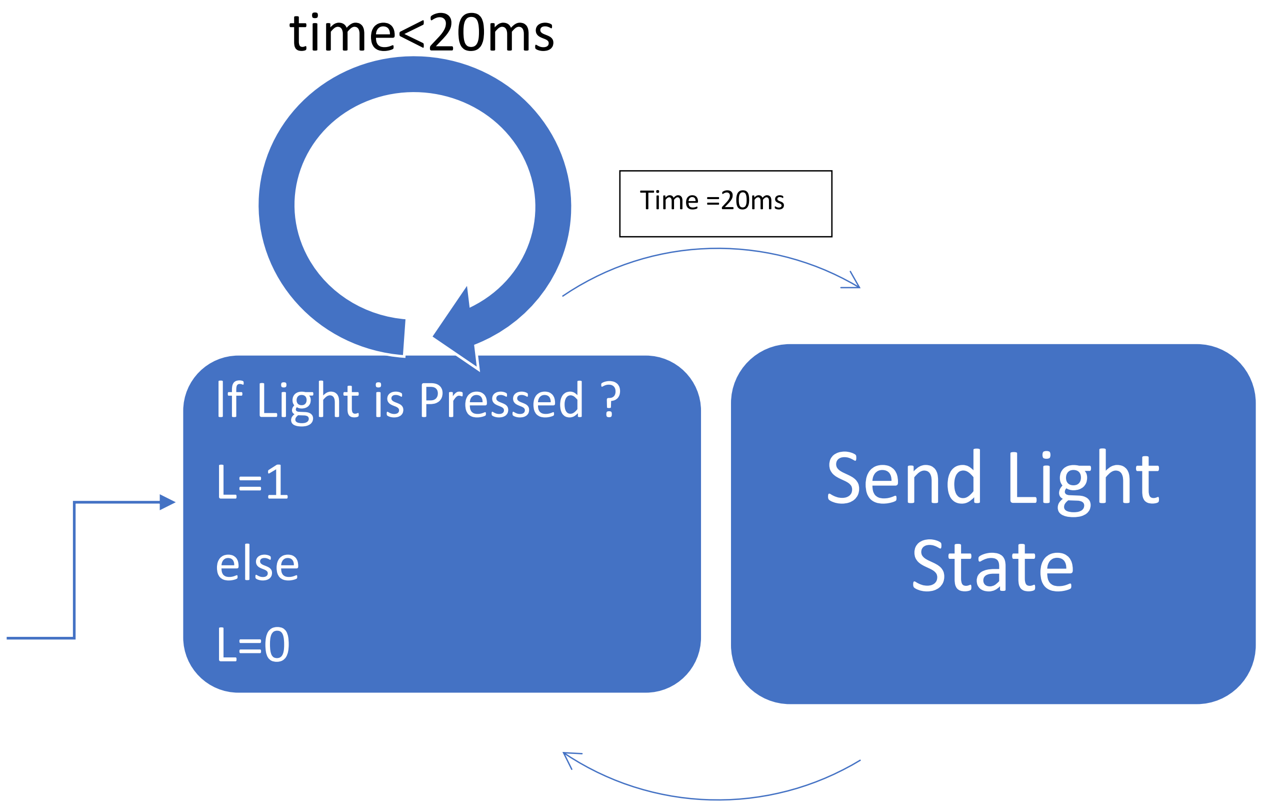
Dynamic Design

For ECU1

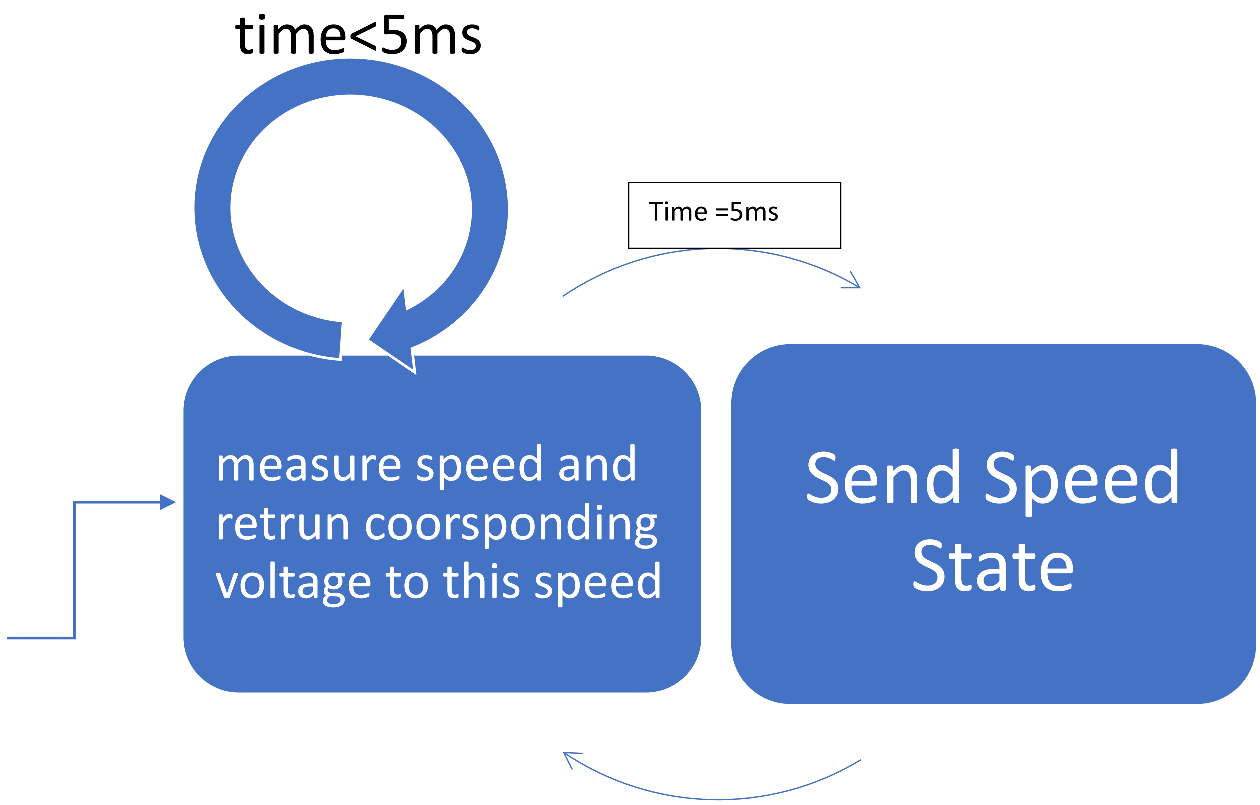
State Machine of door



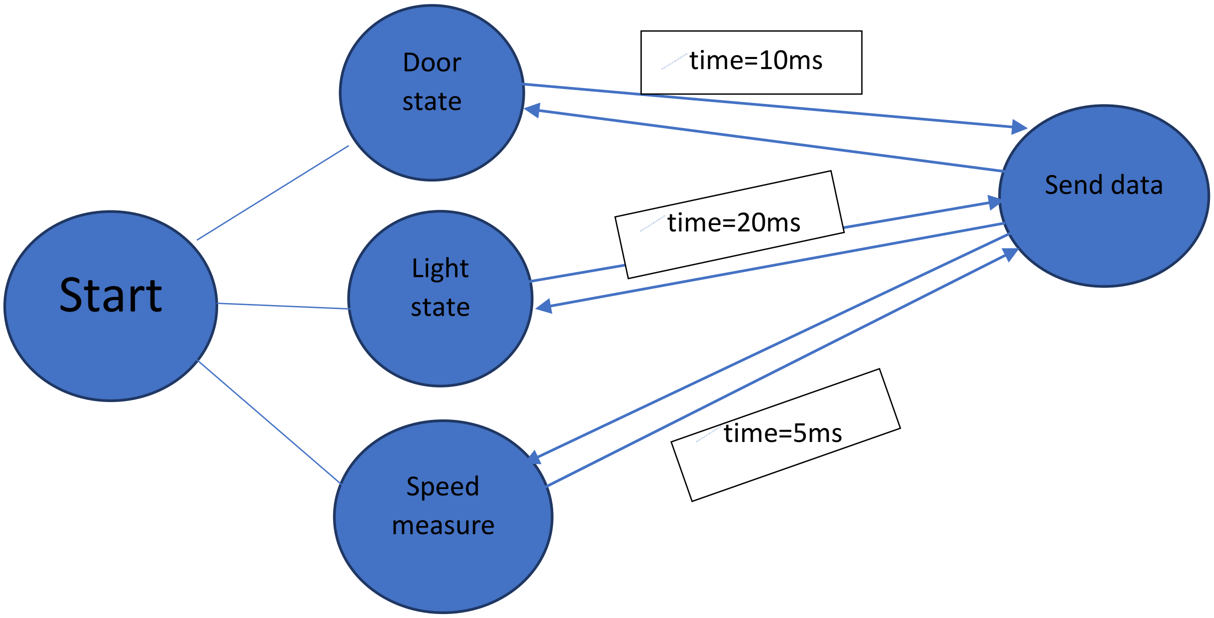
State Machine of Light



State Machine of speed



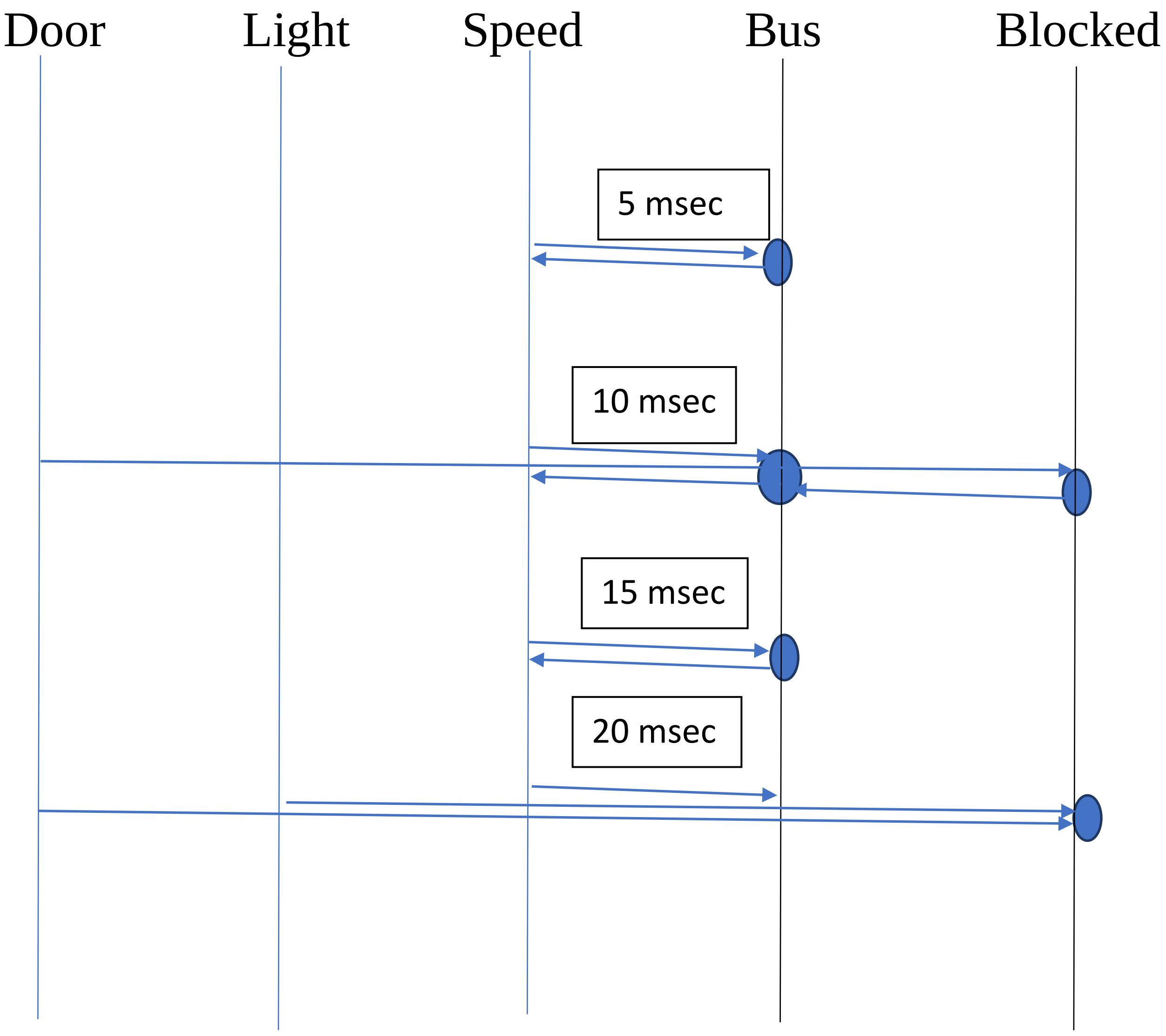
State Machine of operation:



Note

- If two states must send in same time together, in this case the highest priority will send first.

Sequence diagram



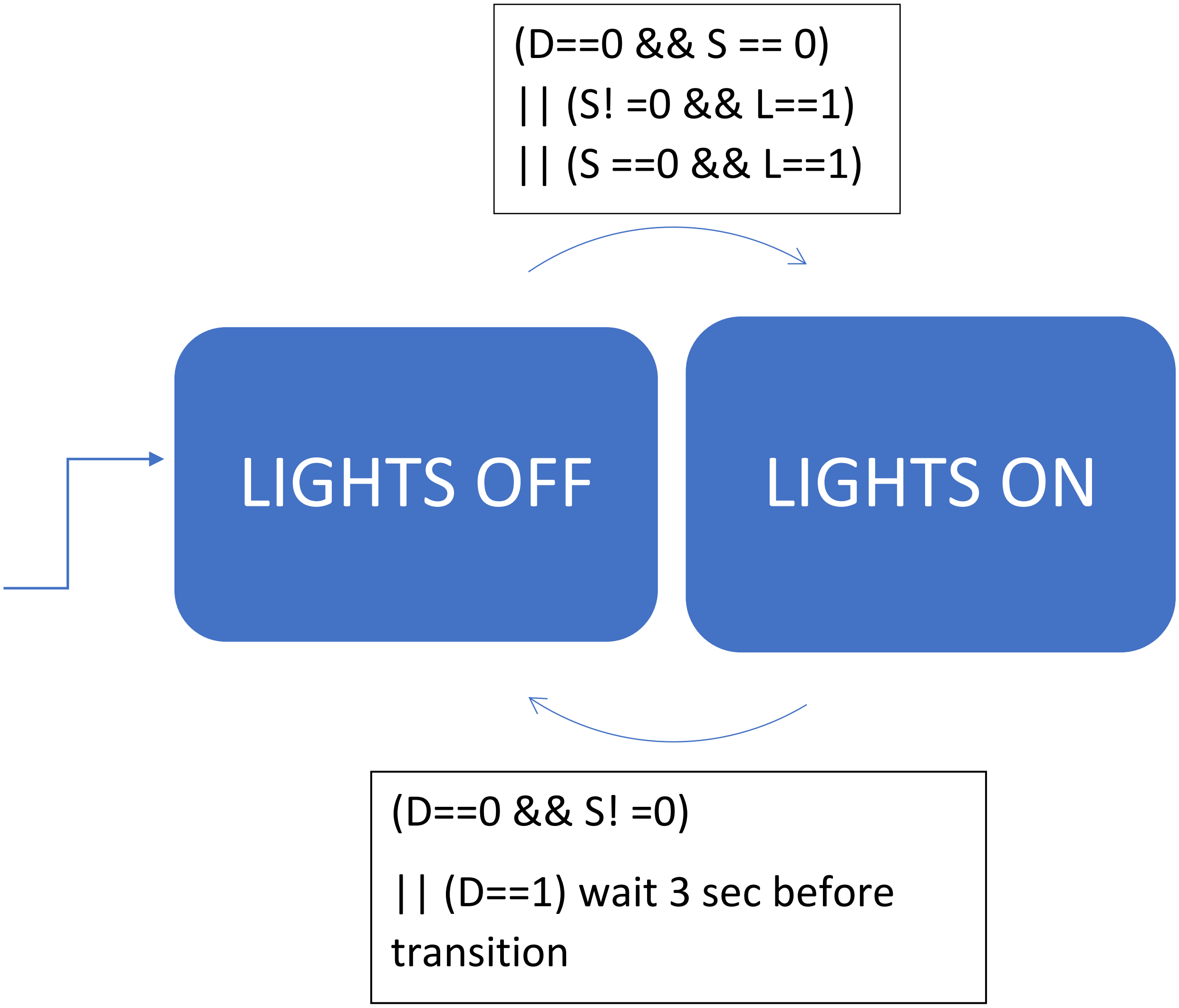
CPU LOAD:

Assume Execution Time for all tasks = 2 msec

CPU Load = (6/20) = 0.3 = 30 %

For ECU2

State Machine of LL and RL

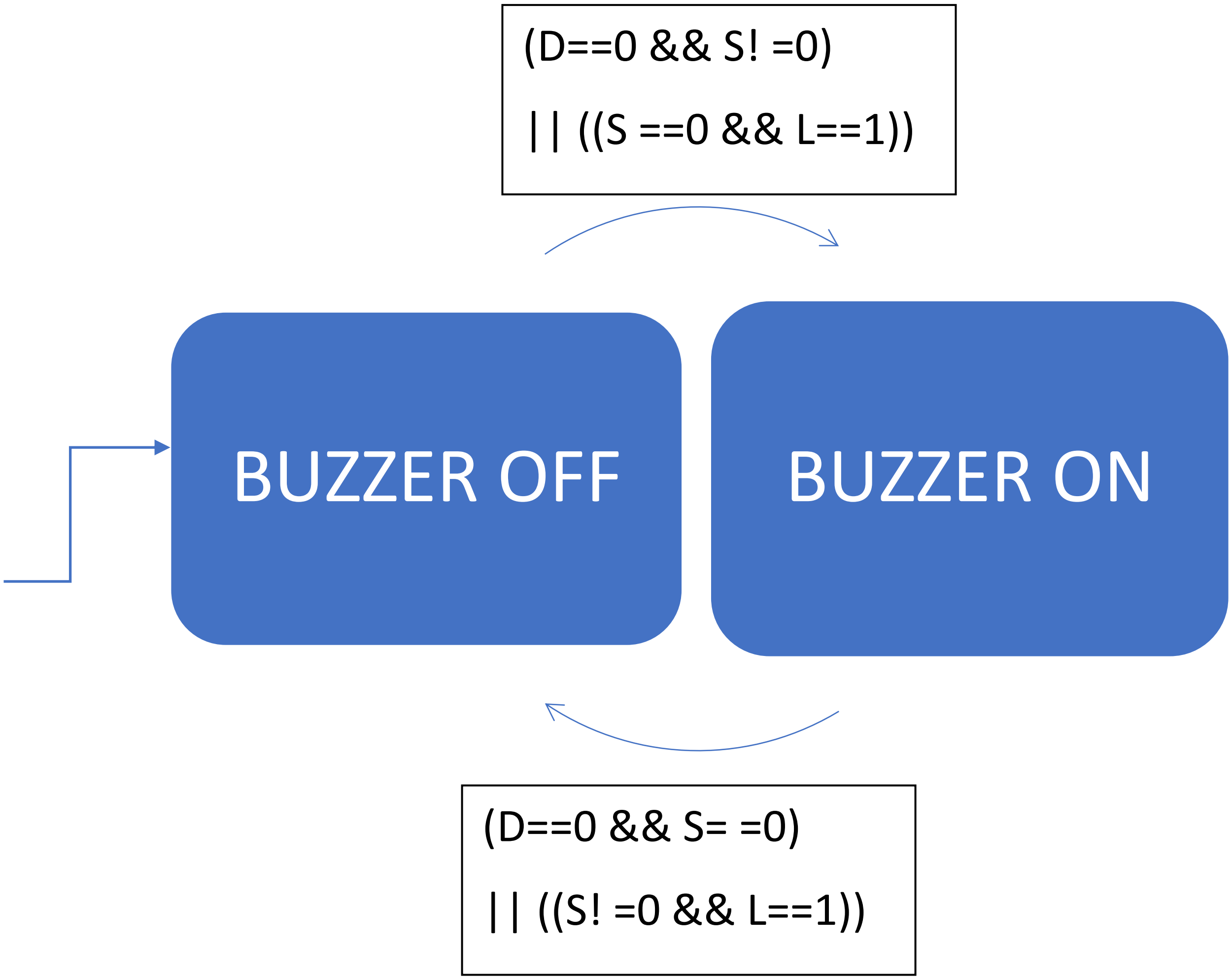


(D==0 && S == 0)
|| (S! =0 && L==1)
|| (S ==0 && L==1)

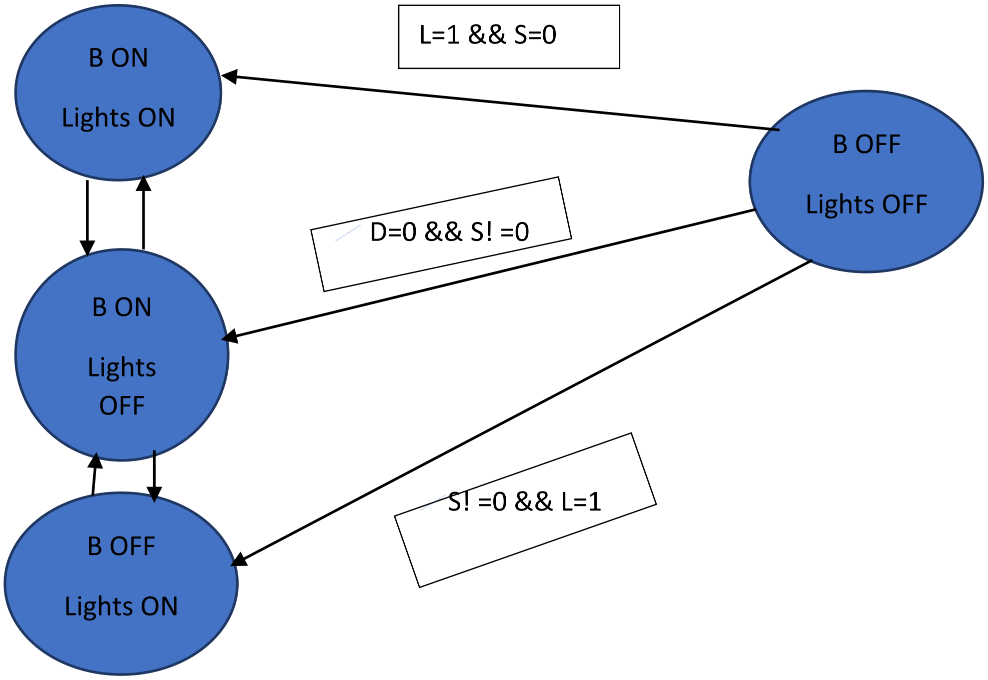
(D==0 && S! =0)

|| (D==1) wait 3 sec before transition

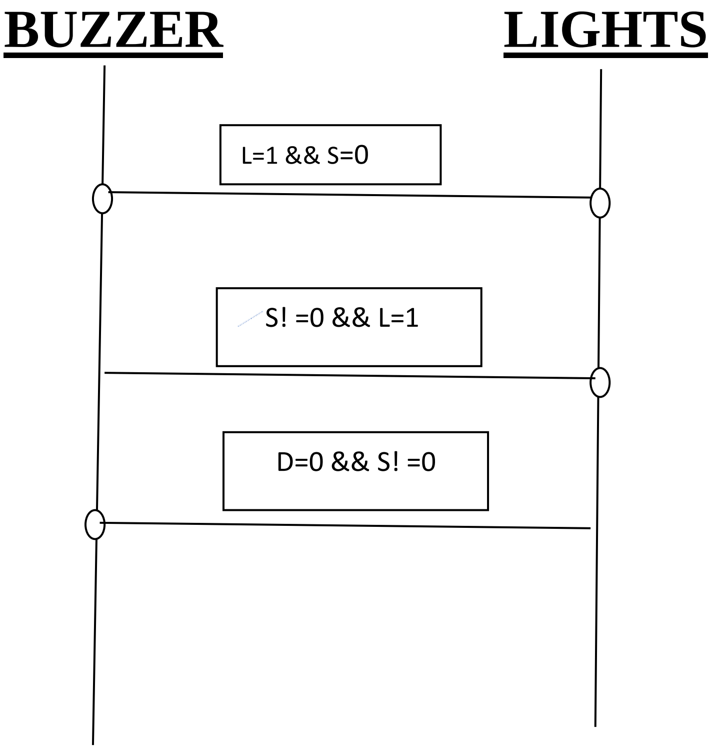
State Machine of BUZZER



State Machine of operation:



Sequence diagram



CPU LOAD:

Assume Execution Time for all tasks = 2 sec

CPU Load = (6/20) = 0.3 = 30 %

BUS LOAD:

BUS LOAD = (1/5Sec) = 20 %